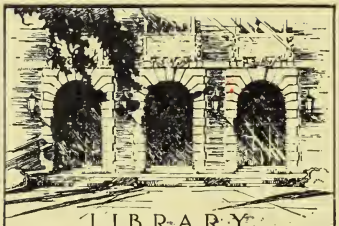

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AERONAUTICS BULLETIN : NUMBER TWO

UNIVERSITY OF ILLINOIS
INSTITUTE OF AERONAUTICS
URBANA, ILLINOIS

LANDSCAPE PLANTING FOR AIRPORTS

By Florence B. Robinson

UNIVERSITY OF ILLINOIS BULLETIN

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AERONAUTICS BULLETIN — NUMBER TWO

LANDSCAPE PLANTING FOR AIRPORTS

BY
FLORENCE B. ROBINSON

Associate Professor of
Landscape Architecture
University of Illinois

PUBLISHED BY THE UNIVERSITY OF ILLINOIS, URBANA
1948

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FOREWORD

THIS MONOGRAPH is the second of a series of service bulletins on aviation subjects which will be issued from time to time by our Institute of Aeronautics. It concerns a comparatively modern subject — landscape planting for airports — which has been practically untouched both in literature and in practice, and which, in view of the unprecedented growth of airports during the past year, is particularly timely. The monograph, since it stresses fundamental principles, possesses more than a passing value.

Miss Florence B. Robinson, the author, is Associate Professor of Landscape Architecture at the University of Illinois. She has had wide experience as a teacher, author, and lecturer in the field of landscape architecture. Her latest book, *Planting Design,* is widely recognized as a valuable addition to the literature on landscaping.

Miss Robinson wishes to express her appreciation to her colleagues who have generously aided in the preparation of this bulletin — to Professors O. G. Schaffer and K. B. Lohmann, Landscape Architecture, for their encouragement, suggestions, and helpful criticisms; to Dr. R. F. Fuelleman, Agronomy, for his suggestions and data on grasses; and to Professor H. W. Shepherd, Landscape Design, University of California, Berkeley, for reviewing the list of West Coast street trees.

The Institute of Aeronautics is glad to make available the information contained in Miss Robinson's monograph. In it, as in all publications of the Institute, the author has been given complete freedom to express any opinions she may wish with the understanding that she takes sole responsibility therefor. Those who, in planning an airport, follow the practical suggestions presented will find them of inestimable value in helping that airport to become a monumental gateway to the community which it serves.

Leslie A. Bryan
Director

March, 1948

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LANDSCAPE PLANTING FOR AIRPORTS

INTRODUCTION

Successful landscape planting requires a knowledge of the principles of design and the behavior of plants. The purpose of this bulletin is to show how these principles apply to airport planting. It provides a working basis for determining which plants to use, how to group them, and where to locate them. Trees, shrubs, and other plants suitable for airport planting are listed, together with notations concerning their growth characteristics. Finally, there is a summary of the economics of various types of planting, the effect of soil conditions, wind velocity, and all other such factors which will affect planting about an airport.

Definition of Terms. There are prevalent two separate and distinct concepts conveyed by the word "landscaping": first, the popular usage of the term seems to regard landscaping as a matter solely of providing and setting plants after all other planning and construction has been completed; and secondly, the professional attitude regards planting as a small part of a larger whole — as the final phase of a complex and cooperative process of designing or planning for combined use and beauty. In this concept plants are the palette of an art in which the final harmony of line, form, texture, and color is related to a complete plan, made in cooperation with engineers and architects, to minister to the needs, comfort, and pleasure of aviation and of the people whom it serves. Utility and beauty are wrought together.

While the first concept is popularly and widely accepted, it is really inadequate, inefficient, and accidental in its formation, and results obtained by following this interpretation are seldom satisfactory. Consequently, the first work done under this concept is followed by a continual series of changes and adjustments. The planning which might better have been done on paper in the draughting room is accomplished finally through a lengthy and costly procedure of trial and error.

The second concept calls for a plan which starts with the beginning of the general plan and is developed in cooperation with all the other designers working on the project. In such a plan the final

beauty of effect has received proper consideration, along with the utility and efficiency of the general layout. The interaction of all the phases of design and of construction have been deliberated and understood. The resultant functional pattern is combined with the softening values of plants to accomplish an effect of threefold merit:

1. The physical satisfaction and emotional appeal of fine masses well placed, of well-considered and balanced textures, and of good color combination.

2. The intellectual challenge of a good plan simply and clearly presented and correctly focused, wherein the overlay of plants is designed to complement the plan.

3. The spiritual quality of light balanced by shadow, of space opposed to mass, of an innate and proper character built into every part of the design, including the planting.

Objectives in Planting. Three objectives in planting should be: (1) better effects with increased beauty and harmony; (2) greater efficiency; (3) lower maintenance. The attainment of these objectives is not a matter of accident or happenstance. It is the result of carefully planned and well-considered design, not only of the field and traffic, but also of everything that is to become a part of the port, including the choice and arrangement of the plants and other decorative or recreational features.

Statement of Art Principles. The principles that govern all art are applicable to landscaping and planting. Through these principles the triad of art and of life is expressed. The aim of all art is harmony; and harmony is attained by the application of three major principles to the use of materials:

1. Simplicity — a few things well placed, with a repetition of units running through the whole.

2. Continuity — a scale relationship that is continuous throughout the project and an axis that ties the whole together and about which all parts are balanced.

3. Principality — the creation and holding of a chief center of interest or focus about which other items are arranged in a sequence that leads to or from this center.

The three principles must be incorporated in every phase of planning and of planting, if these are to be adequate and satisfactory. In planting design they must be applied alike to mass and form, to texture, and to color — the three design factors in plants. Thus planting as well as planning becomes an art of design.

Value of Beauty. The airplane's effect on the environment of man is pronounced and evident. The effect of that changed environment upon man himself is as yet too little understood or even considered. The marvel of the airplane as a means of transportation is still in the ascendancy, but the airplane as a modifier of human life and living conditions is yet to be fully studied and information about it compiled. In that compilation, beauty will be a definite factor of consideration, for beauty is a vital factor in living and in the development of human life and character. The effect of airport construction on the landscape; the effect of the landscape on people; and the resultant need for beauty for the sake of its effect on people, and at the entrance to a city, are all matters for our concern.

The speed of development of this new mode of travel has heretofore prevented sufficient regard for surroundings and their beauty of effect. But beauty is important to human well-being; it even has an influence on human safety. Harmony in our surroundings tends to relieve tension and so contributes to human efficiency and safety.

That there are objectionable features to be remedied, as well as great advantages, in each airport is generally recognized. Thus, good planning and reasonable, well-designed planting are growing needs. The cooperation of all the designers involved — engineers, architects, and landscape architects — is needed from the very start of the project. The time to call in the designer of planting is before a spadeful of earth has been turned or a building site located.

If the finest results in beauty, as well as in convenience of functioning, are to be attained, there must be well-designed plans for all phases of the project, all begun at the same time and evolved together. Cooperation is essential. Beauty is seldom achieved as an afterthought. It must be planned from the beginning. Time is an element in its development.

There is an interrelation between the site conditions and the planting design. Because of this interrelation it is the more important that both be developed together. If separated so that the construction precedes the planting plan, it frequently happens that the ideal effect is blocked or made impossible by some item of construction that could have been avoided by cooperative planning. For instance, on paper underground constructions and grid patterns

along straight lines may seem most desirable to the engineer, but often a slight deviation, that does no essential harm to the work of the engineer, will make possible some surface beauty that would otherwise be lost.

The engineering aspects of approach zones have been discussed adequately in books and bulletins, both as to horizontal and vertical dimensions and requirements; and runway layouts have become more or less standardized. But the approach by land, not air, the adjacent land usage, and the effect of beauty or bareness thereon need further discussion and enlargement. Some of the objectionable features of airports can be overcome by good planning and by well-designed planting. Noise is a problem for the engineers to deal with, but ugliness, barrenness, glare, and dust are overcome largely by proper planting.

Airports, being closely related to the life of cities, should be integrated with city plans; the beauty of the two as a whole should be evolved simultaneously. And if, as has been said, it is "the duty of the municipality and the region not to offer to the sight of those who travel over it . . . anything unnecessarily offensive by reason of ugliness, and not to deface the present beauty of the landscape,"[1] is it not also the duty of airport officials to maintain the port and its immediate surroundings in a pleasing and agreeable state?

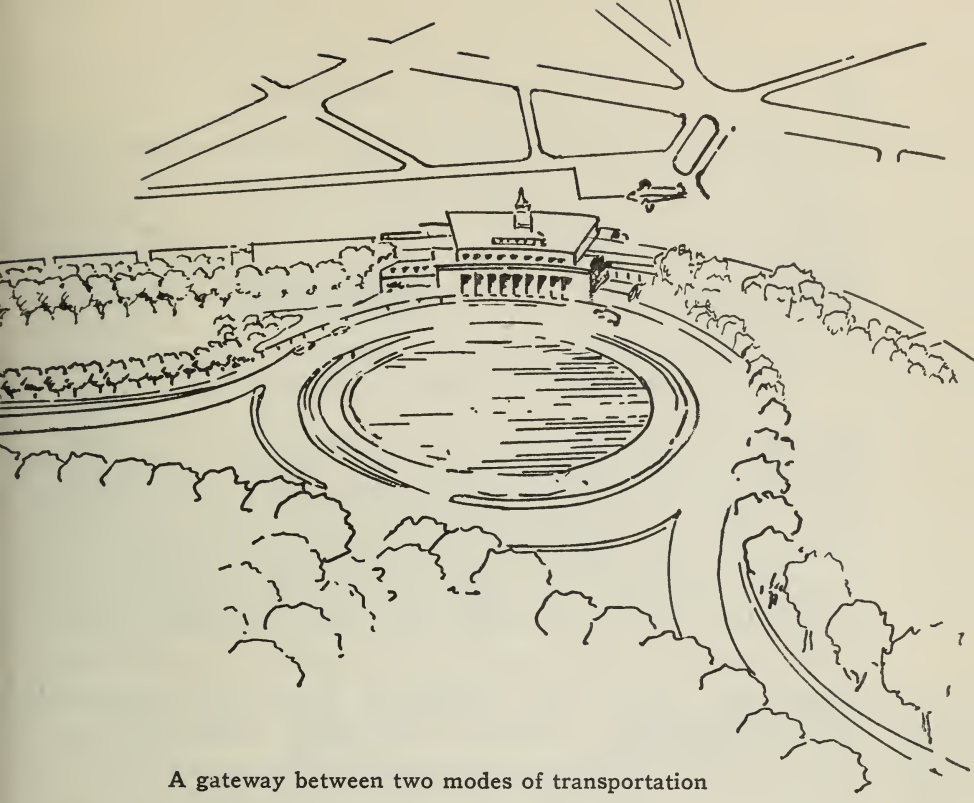
APPROACH DESIGN

Approach by Air and by Land. An airport is a gateway to a city, a connection between two modes of transportation, a junction between air-borne and earth-borne traffic, a link between the infinity of space and terrestrial solidity. Through it mankind moves to greater freedom and wider human relations. It should express the dignity and power of this keystone position. The planting, when well done, is a large part of this expression.

There are two approaches to an airport to be considered. The first is from the air, and the second is from the ground.

The approach from a plane affords a bird's-eye perspective in which the ground pattern is, or should be, effective; and in which

[1] Hubbard, Henry V., McClintock, Miller, and Williams, Frank B., *Airports; Their Location, Administration and Legal Basis,* page 36. Harvard City Planning Studies, I. Cambridge: Harvard University Press, 1930.



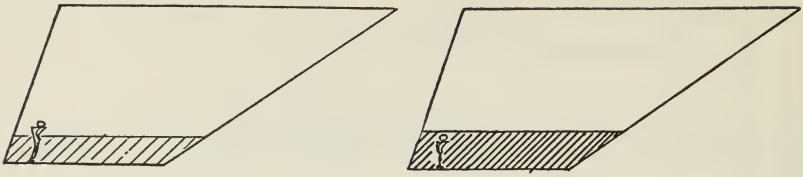
A gateway between two modes of transportation

the balance between the open, sunny area of the field and the heavier, darker masses of buildings and plants with their shadows is evident.

The approach on foot or by car provides an entirely different view in which the elevations count most and buildings and plantings are important in their relationship of design.

Between the travelers coming from these two approaches stand the buildings. Passengers on planes debark and pass through the buildings to cars waiting on the other side to transport them to the city center. For them the major view is the bird's-eye perspective seen from the air before the plane lands. Passengers coming to embark arrive in cars, which may require parking space, and pass through the buildings to planes on the field. For them the important view is the approach to the buildings and the perspective of the planting against the buildings. In both cases the dignity of this gateway and the importance of the city it represents must be expressed in the landscape arrangement.

Power and dignity are best expressed by a formal treatment. Moreover, there is a functional aspect in the planting as a directive



Weak tone balance Better tone vs. space

There should be a balance of tones in the plan.

for traffic of all sorts. Thus the planting on the field side of the buildings directs the foot traffic to and from planes, while the planting on the city side directs cars and people coming to and going from the airport. This dual role of function and character is expressed in the choice and arrangement of plants. Hedges bordering ample paths or walks accomplish this readily. Specimen shrubs or small trees add needed shadows for interest and, when suitably placed, may enhance the architectural design with harmonizing textures and colors. Architecture and plants should blend into a single picture. The picture as a whole is more important than the plants. Consequently, plants that do not blend should be avoided.

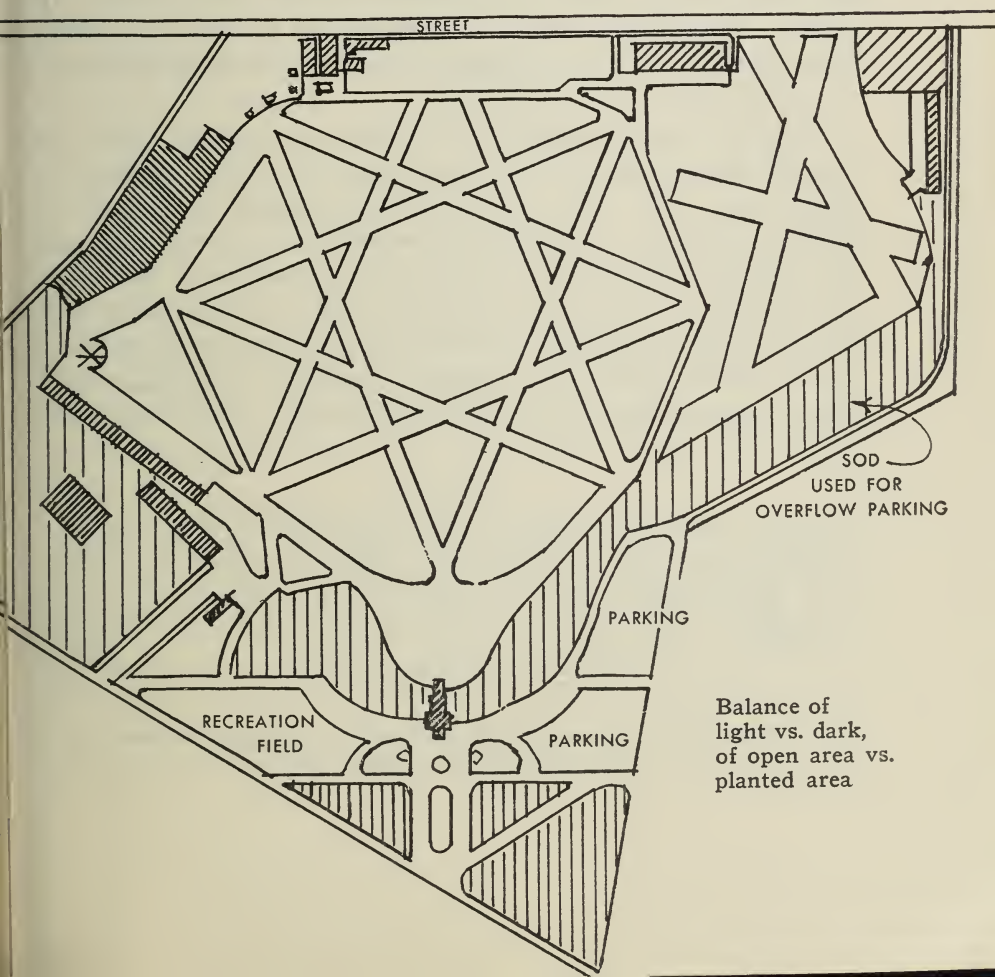
The fact that few incoming passengers really will note this scene or take time to view its excellence is offset by the effect on the outgoing group who must linger, waiting for the call to their plane, and who, during this enforced leisure, have time to see the picture. For them, there is from the building a foreground of short shadows and variety of tones backed by a vast, open, sunny space. Here the shadows and darker tones are in the foreground and the glaring light at the rear. Thus, by contrast, the eye is focused and the interest centered on the point of departure.

For the sake of tone balance, texture balance, and general balance of mass against space, this foreground planting needs to be dense, medium to coarse in texture, dark in tone, and of sufficient extent to serve its function as the foreground of a large, open space. Shearing for hedges will produce the first need of density. The choice of plants for size of foliage and darkness of color tone will give qualities of texture and weight. The extent allowed the planting will create balance of foreground against background.

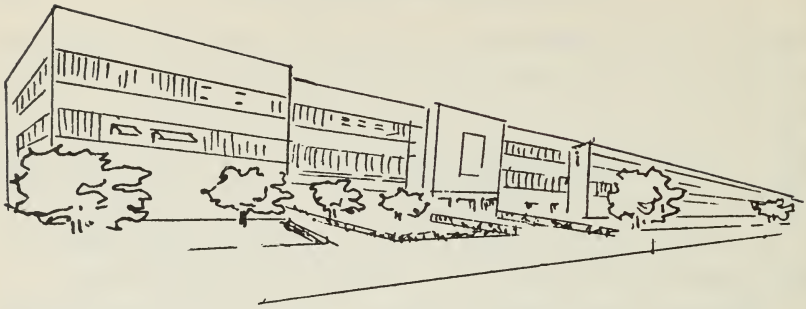
On the city side of the building one emerges to an area in which the tones are reversed — the open area of walks and drives is

smaller and the planted area is larger in proportion. Again, as always, there must be balance, but here its arrangement is different. Greater variety and intermingling of colors and textures are advisable. The balance is of color and color tone — between dark and light, shadow and sunshine — as well as of color with color and mass against mass. Composition is more varied, and interest may be diversified. But the choice and arrangement of plants should be determined by the requirements of harmony in a good design.

Balance in the Design. Balance is one of the fundamental principles of art always to be applied to design — any design. In beginning the study of airport planting, balance is perhaps more subtle and abstract than in later developments of the pattern, but it is nonetheless important. In the plan and planting of an airport, balance is between space and mass, light tone and darker tone, field



Balance of light vs. dark, of open area vs. planted area

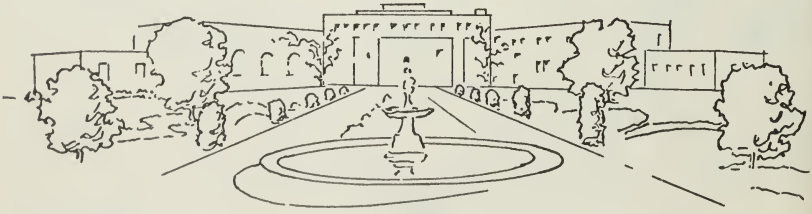


Scale relationship is important — use small trees against large buildings.

area versus the other areas about it. This balance of masses and tones is more evident from the air, less so from the ground.

Focus. The point of embarkation and debarkation is properly the focus of the whole plan, the center of interest about which everything else revolves. This focus of the plan is also properly the focus of the planting and is to be emphasized in the use of plants. The planting plan creates the same focus in its scheme. All the planting is designed to accomplish this.

Principles of Art Applied. With the control tower atop the administration building, the entrance and exit of this building determine the axis of balance. All planting should be designed to balance on this axis, whether symmetrically or asymmetrically, and to emphasize the sequence leading thereto. The plants chosen for use here must conform to the requirements of such a pattern, as well as be able to survive the soil, moisture, and exposure conditions of the site. The first consideration is design, then ecology, and, finally, appeal quality. When a planting fails to attain its utmost



Pretentious and costly — the elaboration of this expression can be simplified for smaller ports.

beauty of effect, it is due largely to a disregard or lack of understanding of the three principles of art as applied to the use of plants.

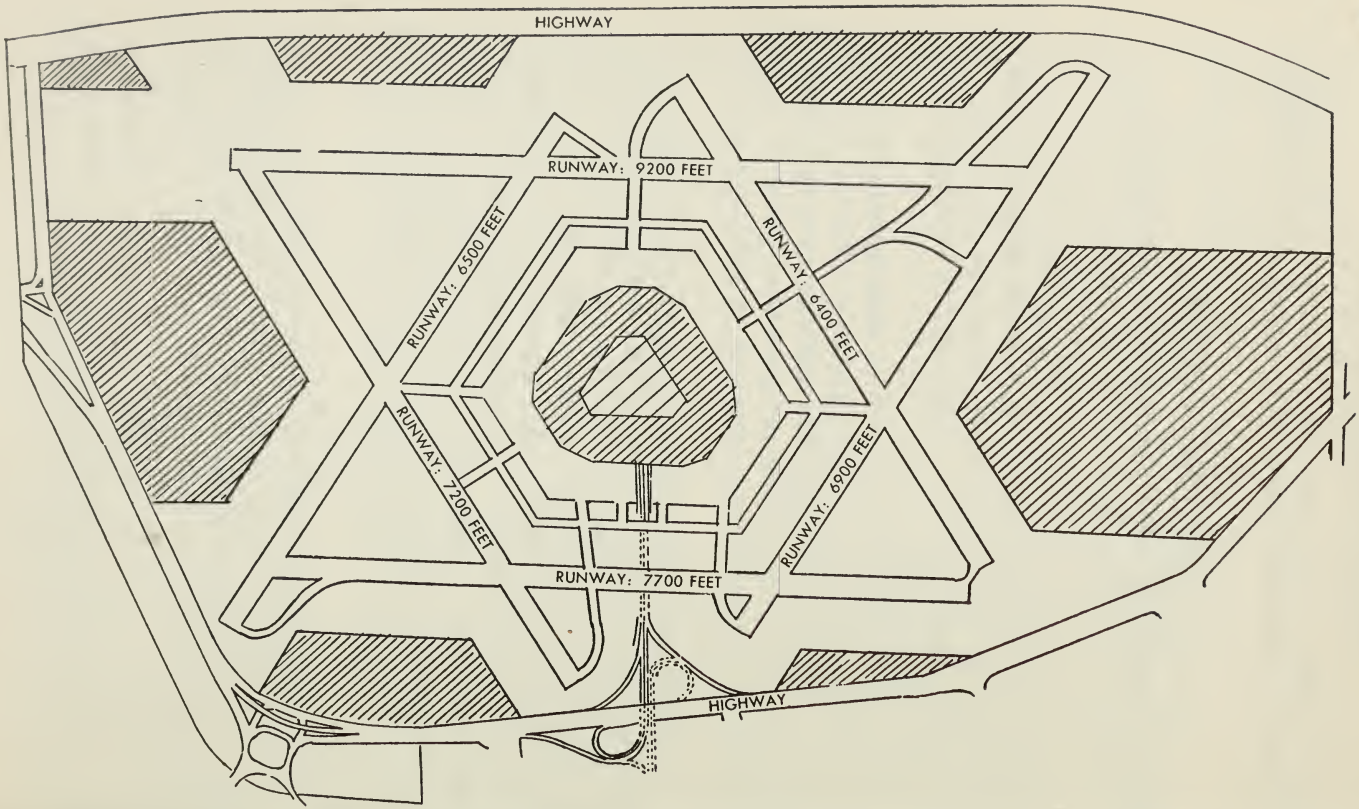
PLANTING DESIGN

Planting Limited by Field Pattern. Each advance in airport development is distinctly traced on the field patterns seen on plans, or from the air. The buildings are always placed where they will present the least interference with landing or take-off. The resultant plan shows the building groups and their surroundings concentrated in the angle of least frequent take-off between the runways, or in a central island more or less surrounded by runways. Planting is limited by this pattern.

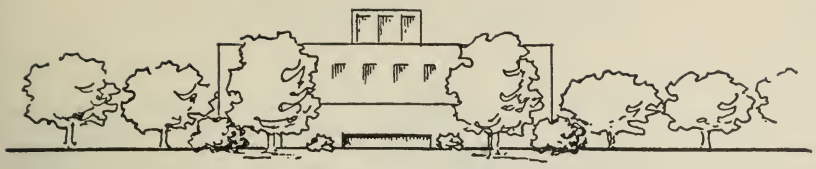
Access to the central island by car or afoot is through a tunnel, and the island as seen by either approach — from the air or the ground — is a barren area with bald buildings sitting lonesomely in the midst of empty space. Heat and glare characterize it. And the fantastic shapes of this island, often seen on plans, are no alleviation of the problem.

The old idea of curved lines as "lines of beauty" has been discarded in good landscape practice. Neither curved nor straight lines can be regarded as beautiful unless they are in harmony with the lines and forms around them. If the island pattern is used, the island must be large enough to allow space for both use and beauty. The space must be sufficient to permit some planting of a size and shape harmonious in outline with surrounding lines and forms. If the angle pattern is used the planting can be more effective, and it will extend from the building façade over the parking areas and the approach. Moreover, this approach ties it to the city and the city plan.

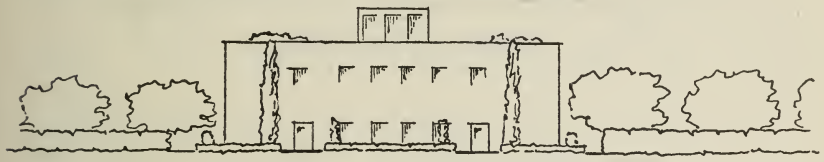
Functions of Plants. Planting is the final and more aesthetic phase of a landscape design. It is determined by the principles on which the whole design is based; it is affected by the construction that has preceded its consummation; and it is chosen with reference to the factors of design, of ecology, and of local conditions. As with all other types of buildings, the arrangement of plants around airport buildings should bear a relation to the architectural design. The function of airport planting may be: (1) to enhance and set off



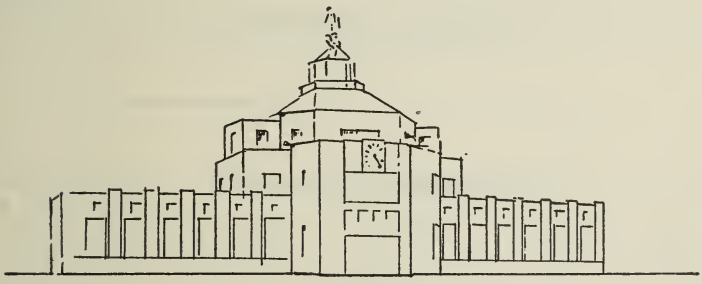
Building on central island needs a planting strip around it. Areas suitable for buildings can permit plants also.



Land approach



Air approach

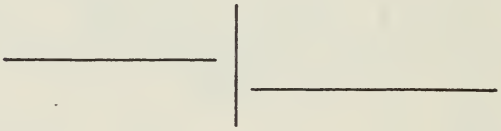


Land approach

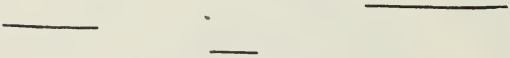
Analysis of building and planting masses

Planting designed on analysis above

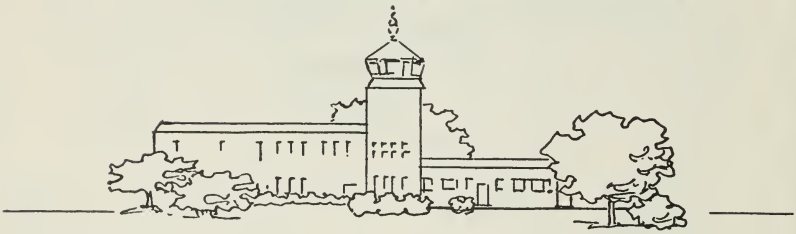
Building without plants



Analysis of building masses



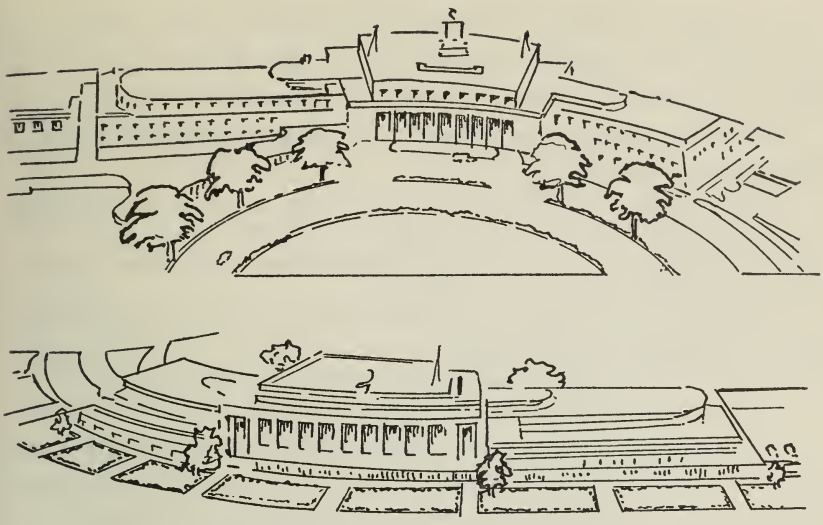
Complementary plant masses



Planting designed to complement the building

the beauty of the architecture; (2) to modify the appearance of proportion; (3) to conceal bad lines and poor materials.

Plants Around Buildings. In the earlier airports the architecture seems to have been largely in the style of late Victorian adaptations (if they had any architectural merit at all), but the more recently constructed buildings are almost entirely modernistic, paying attention to function rather than to decoration. They are of bald masses with little ornamentation other than that of the ma-



Approach by air and by land*

terials themselves, with ample apertures for light and ventilation, and with emphasis, if any, on horizontal lines and shadows.

Since the dominant lines are horizontal, the plant masses should relate to that characteristic, and the internal shadows in the plants should also be horizontal for the sake of line harmony. The plant masses should complement the building masses. The building color will determine the colors to be used in plants. For instance, the soft-toned reds of present-day bricks call for bright greens or blue greens. If the brick is yellow-toned, then the red hues or tones should be avoided and yellow-greens used instead. Building color and dominance of color in surroundings need to be considered in determining plant hues to be used. Background colors are a part of the total color pattern; if the plant hues are not harmonious with these, the result is less effective than it could be.

The texture and character of the planting should be in harmony with the texture effect of the building and its surfaces. In most cases a medium texture is called for, neither very fine nor very coarse. Very fine textures are recessive and delicate; very coarse textures

* These drawings are suggestive and not final studies since the author is unfamiliar with the sites shown. They are offered in order to show how the planting design is wrought with the building design.

are aggressive and harsh. Neither type is suited to the character of an airport, and seldom is either suited to the texture harmony required. If coarse is contrasted with fine, an accent is created.

The art principles already mentioned are applied to this part of the problem thus:

1. The focus or chief interest is at the main entrance to the building. This determines the main axis of the planting scheme.
2. A sequence of interest in the planting echoes the windows and main shadows and their sequence of effect.
3. Balance in the planting is related to balance in the building design, and thus maintains the same axis.
4. Scale relationship is maintained in mass and texture and color.
5. Simplicity indicates restraint in the choice and arrangement of plants.

This is the secret of good planting around any building: A few plants of proper growth, texture, and color, arranged to create a correct balance with the main axis, and leading to a focus at the point of entrance. To observe these few principles is to avoid mere collections of plants. Choose wisely and arrange artistically, and beauty results.

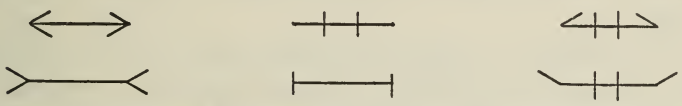
Where building proportions need correction, as in the case of a too tall structure or a too long and low structure, optical illusions can be created to modify the proportions. For the too tall structure the effect is modified by contrasting it with a form or forms still taller in proportion to width. It may be benefited further by cutting off a segment at the base by a dark line, as with a hedge. For the long, low building the use of inswinging, outswinging, or division lines will change the effect and reduce the appearance of length.[2] Thus the ends of the building will be covered with ascending, spreading branches and the façade crossed with verticals, dividing it in this way into rectangles of more pleasing proportion. The chief difficulty here lies in the fact that the plants used must not grow so high as to block visibility from the reconnaissance tower. A knowledge of ultimate growth in height and spread is important.

The problem of concealment is generally answered by the use of vines. The majority of vines are twiners and must be provided with some support, but there are a few vines that cling readily to

[2] Adapted from Bottomley, M.E., "Plant Form in Relation to Buildings," *Landscape Architecture*, July, 1928, Vol. 18, pp. 277-281.

Proportions similar — no change in effect.

Contrasted proportions make the central figure appear broader.



Inswinging, outswinging, or division lines affect the appearance of length. Use of optical illusions to change the effect of proportions.

any slightly rough surface such as stone or stucco. These vines are also rank growers when once the roots are well established.

Vines that cling by discs or aerial rootlets are:

Parthenocissus tricuspidata and its varieties — Boston Ivy.
Hydrangea petiolaris — Climbing Hydrangea.
Schizophragma hydrangeoides — Japanese Climbing Hydrangea.
Hedera helix — English Ivy (not reliably hardy in the north).
Ficus repens — Climbing Fig (not hardy in the north).

If the surface is large and monotonous, a plant of contrasting texture, but similar foliage color, may be laid against this wall of foliage to create interest.

Trees in the Parking Area. Parking is an essential at an airport, both for cars and for planes, and is a problem to be solved in the original planning. Mathematical calculations provide a definite ratio between traffic loads on planes and the number of cars to be provided for. Future development as well as present-day ratios must be considered. Also the extra overflow for special occasions calls for additional temporary use of areas adjacent to the normal parking space. All such calculations have been discussed in other literature on airports and this bulletin mentions them only to call attention to the size of such areas and their need for shade.

Trees with broad-spreading branches and with deep-descending roots or with taproots, planted in rows, provide much-needed shadows which car owners will greatly appreciate through the hot days of summer. Angle parking on the north side of such tree rows with a curb placed three feet from the tree trunks will stop the

rolling wheels before the bumper bruises and damages the bark of the tree. The small space thus pre-empted from the parking area is more than compensated by the benefits of shade.

For this purpose some species of Platanus—Plane-tree or Sycamore — is very suitable. Oaks are good though mostly slow growing. Trees recommended for streets (page 20) should also be suitable here.

If the parking for planes is well to one side of the field, near hangars and other buildings, it might be possible to provide some shade here, too, though it obviously would be less adequate. Only an ancient Live Oak would spread widely enough to really overhang a plane. But, on the assumption that "something is better than nothing," shade is to be recommended for all parking.

TREES, SHRUBS, AND OTHER PLANTS

Use of Trees, Shrubs, and Other Plants. Modern architecture is severe in its block masses and simple lines and surfaces, and it seems to need the softening effect of free-growing foliage. Yet the character of the airport calls for formality. The resultant plan with its formal hedges, therefore, will need to be softened by free-growing shrubs and trees whose arrangement in the plan must be determined by the design of the architecture. Choosing the plants needed to fulfill the design of the architecture involves the factors of design, ecology, local conditions, and mass appeal.

Plants Along the Approach Drive. The city and the airport are closely related, yet, because of space limitations, the airport generally must be constructed at some distance from the center of the city. This necessitates a consideration of the connecting boulevard or highway. Planting is an important item along all trafficways. The integration of the airport and the connecting trafficway with the city plan is essential today and, in the larger cities, the trend seems to be toward providing dual highways of one-way traffic separated by a planting strip. This will allow at least three rows of trees for shade on the highway and possibly some shrubbery in the central strip and at the sides. The arrangement of these trees and shrubs is a part of the city plan. But, inasmuch as the trees

and shrubs used here will carry over into the airport planting as a matter of unity, it seems advisable to consider the requirements to be met by these plants.

Requirements of a Good Street or Trafficway Tree. The ideal street or trafficway tree should be:

1. Entirely hardy in the region of use.
2. Fairly long-lived.
3. Moderate in rate of growth, not too slow.
4. Of an ultimate height and spread suited to the width of the street where it is used.
5. Naturally high-branching, with ascending branches.
6. Possessed of a firm and tough bark, not easily bruised or damaged.
7. Strong of fiber, not brittle nor given to breaking easily in storms.
8. Neat, not messy, in its habits — not dropping a constant litter on the ground around.
9. Clean and free from insect pest and disease.
10. Possessed of foliage of a good color that washes clean in rain, and is of long duration.
11. Tolerant to the smoke, soot, dust, and gases of the street or highway.
12. Providing a moderate shade, but not so dense that walks and pavements beneath it stay wet unreasonably long.
13. Possessed of a compact and restricted root system or one capable of enduring restriction.
14. Able to survive with a minimum of food and moisture.

In summary, a good street tree should possess good form, good color, good texture, and good habits.

This is the *ideal.* By this standard, there are only a few trees suitable for trafficway or street use, and these few are the ones to be preferred. A very few others fail badly as to the ideal, but have some characteristic so superb as to compensate for their shortcomings. An example of this is the American Elm, which is probably the favorite street tree in America. The American Elm fails badly in the matter of cleanliness and freedom from disease, but it has a form so superb and outstanding that its use on streets is tolerated, even advocated, in spite of its defects. Even when serious diseases are ravaging elm plantations everywhere, Americans are still loathe to cease using it. Its magnificent form, its rapidity of growth, and its tolerance to handling and abuse continue its popularity and compensate for its defects.

Trees Recommended for Streets and Other Trafficways

NORTHERN STATES

Celtis occidentalis — Hackberry (subject to Witches Broom).
Ginkgo biloba — Maidenhair tree (slow growing).
Liquidambar styraciflua — Sweet Gum (slow growing).
Platanus acerifolia — London Plane tree.
Quercus palustris — Pin Oak.
Tilia tomentosa — Silver Linden.

Secondary List[3]

Acer platanoides — Norway Maple (very dense).
Acer saccharum — Sugar Maple (fine color, insect pests).
Gleditsia triacanthos inermis — Thornless Honey-Locust (light shade, but messy fruit).
Ulmus americana — American Elm (unexcelled form but afflicted with diseases).

SOUTHERN STATES

Acer rubrum — Red Maple.
Celtis occidentalis — Hackberry.
Delonix regia — Royal Poinciana.
Liquidambar stryaciflua — Sweet Gum.
Quercus phellos — Willow Oak.
Quercus virginiana — Live Oak (slow growing).
Swistenia mohogani — Mahogany (slow growing).

Secondary List[3]

Albizzia lebbekoides — Lebbek Albizzia (messy pods).
Albizzia julibrissin — Silkcrown Albizzia (messy pods).
Bombax ceiba — Ceiba (slow growing).
Cinnamomum camphora — Camphor (slow growing, fruits messy).
Grevillea robusta — Silk Oak (slow growing).

WEST COAST

Celtis occidentalis — Hackberry.
Ginkgo biloba — Maidenhair tree (slow growing).
Liquidambar styraciflua — Sweet Gum.
Platanus orientalis — Oriental Plane tree.
Quercus agrifolia — California Live Oak (slow growing).
Sophora japonica — Chinese Scholar tree.
Tilia cordata — Littleleaf Linden.
Tilia tomentosa — Silver Linden.

Secondary List[3]

Acer platanoides — Norway Maple (dense shade).
Cinnamomum camphora — Camphor (messy fruits).
Eucalyptus ficifolia — Scarlet Eucalyptus.
Eucalyptus polyanthemos — Redbox Eucalyptus.
Gleditsia triacanthos inermis — Thornless Honey Locust.
Grevillea robusta — Silk Oak (slow growing).
Magnolia grandiflora — Big Bull Magnolia (dense and slow growing).

[3] Not so highly recommended, but with some compensatory excellence.

Shrubs. Among the shrubs, the choice for the airport should be made from a list abbreviated by the limitations of public use and of site conditions. Public use requires vigorous growth, complete hardiness, durability under careless wear and tear, and quick adaptability to change in site or conditions thereabouts. The airport site involves much wind exposure and a drier than usual soil. The native plants of the immediate region are more likely to be persistent than introduced varieties, though this is not absolute. The natives are at least indicators of the plant associations that may be expected to do well and are, therefore, desirable. There are many fine introductions that are handsome and attractive. Where these belong to associations similar to the native plants, they may blend satisfactorily with the local vegetation. Caution must be used, however, when mingling the two.

The abbreviated list will contain those plants that possess the following characteristics:

1. Suitable size in ultimate growth.
2. Complete hardiness in the region of use, and long-lived.
3. Foliage of a good green color that washes clean in rain and is of long duration.
4. Freedom from insects and disease.
5. Pleasant effect in flower and fruit, but not of a quality tempting to vandals and not attractive to birds, since birds may become a hazard on the field.
6. Medium texture.
7. Growth lines in harmony with the surrounding trees and shadows.
8. Ability to grow beautifully and persist in the soil, moisture, and exposure conditions of the site.
9. Need of little care or pruning.

Plants of odd or unusual color in foliage should be avoided since such plants never look natural with others. Their freakish foliage usually appears sick among more normal greens. Besides, they are exclamatory in quality — accents that too often are placed where there is no occasion for exclamation. Color freaks belong in plant museums and not in a pictorial arrangement. Each individual plant must be so chosen as to blend with the other plants around it to create an harmonious whole.

Another characteristic to be reckoned with in planning the planting is the carelessness and irresponsibility of the general public toward plants — an attitude that is always amazing to those con-

cerned with plants and planting. Hence the necessity for hedges to direct foot traffic, and borders to protect beds and turf, and the necessity to choose shrubs and trees that will not tempt vandals to pluck the flowers or break the branches. If this general carelessness involved only an occasional flower, little harm might result. But careless breaking of branches or their tips may distort and ruin the growth form of a plant. So, at airports as in other public planting, it is better to avoid the more choice plants of the private garden and to concentrate on good and long lasting foliage effects.

Colored twigs and fruits that are not edible may be used for winter effects and, in the milder climates where they will persist through the years, the broad-leaved evergreens may be useful. But northward the broad-leaved evergreens are inadvisable, and it is wiser generally to avoid conifers except, maybe, far north where they are native. The drainage, wind exposure, and general dryness around an airport do not provide the sort of habitat most suitable to good results among cone-bearing plants. Also, the suggestion of broad-leaved evergreens for the South does not imply swamp-lovers like holly, nor the coarse-textured acid lovers like Rhododendron. Once again the aforementioned characteristics should be considered.

The following are suitable shrubs for an airport. However this is a suggestive list and not by any means complete.

Suitable Shrubs

NORTH

Berberis mentorensis — Mentor Barberry.
Berberis thunbergi — Thunberg's Barberry.
Ligustrum (in variety) — Privet.
Rhamnus (in variety) — Buckthorn.
Viburnum (in variety).

SOUTH

Abelia grandiflora — Abelia.
Bamboos.
Cotoneaster (in variety).
Hibiscus (in variety).
Lagerstroemia indica — Crepe Myrtle.
Ligustrum japonicum — Japanese Privet.
Ligustrum lucidum — Shining Privet.
Palms (small).
Pittosporum tobira — Pittosporum.
Tabernaemontana coronaria — Tabernaemontana.

WEST

Abelia grandiflora — Abelia.
Berberis (in variety).
Chaenomeles lagenaria — Flowering Quince.
Holodiscus (in variety) — Ocean Spray.
Ligustrum japonicum — Japanese Privet.
Ligustrum lucidum — Shining Privet.
Mahonia aquifolium — Oregon Grape.
Photinia (in variety).
Viburnum (in variety).

Vines. Vines are used to relieve a large, monotonously bare surface or to conceal some ugly or unpleasant form or material. In the first instance they should be pruned occasionally and controlled lest they run rampant and conceal that which they are meant to enhance. In the second instance rampant growth is encouraged, since concealment is desired. It is wise to consider this thoroughly before planting the vines. They are slow to establish their roots and do not produce luxuriance at the top until this is accomplished. Thus it is easy to be deceived and to plant too many and too closely. This may be more undesirable than monotony of surface. One vine when grown covers much space. Be conservative in the use of vines.

Ground Covers. At an airport the ground covers separate into two divisions, those for the field and those for the planted area. The requirements for the two areas differ somewhat. In the planted area the ground covers must be vigorous of growth, dense of twig and foliage, of spreading habit, and possessed of a good, fibrous root system. They must cover the soil and hold it, while providing a pleasant green cover.

On the landing field the greater wear and tear of usage modifies the list considerably. Grasses have the precedence of long and familiar service. They have the disadvantage of needing time for recovery if much torn up. The use of grass of some sort is so general that from the first it has been used and accepted as the proper soil cover. Yet the various grasses have each their faults, and it is possible that further and sufficient research might prove other plants of value, perhaps of greater value, for this particular use.

The final material must form a close, even, and smooth mat; be low growing naturally so that it will not require too much care

or cutting; have a good, fibrous root system; and be capable of quick restoration after damage. Possibly some hitherto unused plant of a weedy nature might be better than grass — who knows? Weeds are only "plants out of place" and their ability to persist under hardship might have value here. Certainly the pest of their spread by seeding is no longer a menace to surrounding fields, since this can be controlled easily by chemical sprays.

But the fact remains that the long and extensive use of grass as a ground cover, and the development of machinery and equipment for its maintenance give it precedence over all other covers at present. A cover of some sort is essential to keep down dust and to maintain the level surface in all weather. Even for airports with paved runways the turfed areas are used by the smaller and lighter planes. Where this traffic use is intensive, the turf must be dense, low growing, resistant to wear, and quickly established. Where the traffic is light, it can be thinner and slower, but must still be a low-growing type to reduce maintenance cost.

The requirements of a ground cover are: (1) vigorous growth; (2) density of twig and foliage; (3) spreading habit, closely investing the ground; (4) a fibrous and tough root system.

Thus for an airplane landing is needed a close mat over a matted root system which is tolerant to shearing to keep it smooth and level, able to restore itself quickly if cut and torn, able to withstand heat and drouth, and long lasting.

If there are drainage ditches to be covered, they should be planted with scour-resistant grasses.

On the landing field, ground covers are the only plants allowable. Beyond the landing area boundaries, obstacles heights are controlled by the zoning ratio or glide path. (By zoning ratio or glide path is meant the distance from the end of the runway divided by the obstacle height.) The Civil Aeronautics Administration recommends that the approaches to landing areas shall be clear within a glide path of 20 to 1 from the end of the usable area of the field for its Class I landing facilities, and 30 to 1 for its Classes II, III, IV, and V airports, with the provision that instrument landing runways shall have a glide path of 40 to 1 — this ratio to start at a point 4500 feet from the beginning of the runway. These ratios are minimum.

Northern Grasses Used for Ground Cover

	Summer Color	Winter Color	Age of Maturity	Hardiness to Tough Usage	Speed of Restoration
Agrostis alba—Bentgrass	bright green	green	two years	moderate	fair
Agrostis tenuis and other Bents	bright green	bright green	two years	not too good	slow
Chewing's Red Fescue	bright green	bright green	one year	poor, shallow-rooted	slow
Festuca varieties—Fescues[4]	bright green	bright green	four years	not too good	slow
Poa pratensis—Bluegrass	blue-green to bronze	green	three years	moderate	slow
Trifolium repens—White clover	bright green	brown	two years	moderate	good

Southern Grasses Used for Ground Cover

	Summer Color	Winter Color	Age of Maturity	Hardiness to Tough Usage	Speed of Restoration
Axonopus compressus—Carpet grass	green	green	two to three years	fair	fair
Cynodon dactylon—Bermuda grass[5]	gray-green	green	two to three years	fair	fair
Eremochloa ophiuroides—Centipede grass[6]	bright green	green	two years	fair	fair
Lolium multiflorum—Italian ryegrass	green	green	one year	fair	re-seed
Polygonum aviculare—Bindweed	bright green	brown	slow	good	excellent
Stenotaphrum secondatum—St. Augustine grass	gray-green	green	two to three years	fair	good
Zoysia matrella—Flawn	bright green	brown	three to five years	poor	good

[4] *Festuca elatior alta* and Kentucky 31 are especially recommended.
[5] *Cynodon dactylon* requires heavy soil and moisture.
[6] *Eremochloa* will not thrive in a very moist soil. New strain from Georgia is said to be resistant to brown spot.

Both trees and shrubs must conform to this zoning ratio. This means that a tree that will grow to a height of 100 feet must not be within 2000 feet of the end of the landing strip for a Class I airport. Trees are living things, however, and there is no guarantee they will grow exactly to a certain height, even though the average seems established. Therefore, it would be well to allow a margin of safety, and to choose a tree whose final growth at full maturity is listed at 90 feet rather than 100.

Limitations on Plant Lists. As has been indicated heretofore, not all plants are equally suitable for use around an airport. The character of the place, the site conditions, and the traffic all place limitations on the list of plants proper for such use. The final list will contain only those plants that can persist in good effect under the hardships imposed. Heat and drouth, minimum care, restricted food and maintenance, and careless contacts are all enemies of fine plants. In addition, the design requirements of color, texture, and form harmony further shorten the list. So, finally, the list will contain a few trees and shrubs of long life expectancy, of long foliage season with good green color, and of tolerance to wind exposure, much drainage, and pruning. For, although plants usually will not be sheared, they will probably be broken and damaged by people as well as by storms, and extra pruning will be needed to keep them shapely. Good foliage and fair winter effect are more important than flowers and fruits.

SITE CONDITIONS

Soil. Before plants can be chosen or planted, it is necessary to know the soil conditions. Upon the soil characteristics will depend to a large extent the persistence of the planting. If soil and plants are not suitable to one another, the plants soon die or are maintained only by excessive care. Therefore, in the early investigation of the soil on the airport site, the following data, needed later for plants, should be included:

1. Firmness and porosity.
2. Surface and undersurface drainage.
3. Fertility — minerals present and needed.
4. Alkalinity or acidity.
5. Depth of topsoil.
6. Type of subsoil.
7. Humus content.

Effects of Drainage. Drainage on the field is one of the first problems to be attacked because of its vital effect on safety along the runways. The fact that it is also of essential concern to the future of any planting is an added consideration. Lowering the water table can change completely a natural plant association. The variation may even be extreme, as from swampland to dry ridge conditions. In deciding what plants are best suited to the site after the construction is completed, it is necessary to know what changes have taken place in the moisture content beneath the surface. It is very likely that the native association, formerly on this site, no longer will be the correct choice if persistence is desired. All changes may not be as extreme as above-noted, but any change in soil moisture will effect a change in the plant association.

Surface dust, ground cover plants, and larger plants are all modified by the drainage. The first reaction to this fact is to arrange for surface watering, and temporarily this may seem effective. It will at least benefit the effect through the first summer after installation, provided it is adequate in depth of penetration. But it will not be so effective in prolonging the life of plantings, unless the root systems are naturally shallow and widespreading or capable of extending greatly the depth of their penetration. Vast quantities of water are required to soak down to the roots. Roots must have air and water, as well as mineral food. Surface watering multiplies surface roots, and surface roots are more affected by heat and drouth than deeper ones. The deeper going roots are more important. There is room for more research into the effects of drainage of runway areas on the soil and plants of surrounding spaces.

Not only does the drainage affect the plants, but conversely the plants may affect the drainage. Roots seek water naturally. In some plants this reaction is more pronounced than in others. Willows, Silver Maples, and sometimes Elms will penetrate and clog drainage pipes. Alfalfa has been known to send its roots sixty feet to a moisture bearing level. The location of planting with reference to drainage lines, as well as to the type of plants chosen, needs to be considered from the beginning. The distance from which the drainage line will draw the water from surrounding territory and the amount of lowering of the water table should be studied.

Atmospheric Conditions. Air circulation exerts a very positive effect on plant growth and persistence. Consequently, the following meteorological conditions should be thoroughly analyzed:

1. Direction and duration of prevailing winds.
2. Average wind velocity.
3. Predictability and constancy of wind.
4. Absence of fog and smog.
5. Average precipitation — rainfall and snow.
6. Average barometric pressure prevailing at the site.

Much movement of air is drying in its action, so that plant transpiration is greatly increased and must be offset by more water at the roots, else the plants suffer. And, in regions of high winds, some plants may be distorted and bent or even dwarfed in growth unless unusually resistant to this stress and strain. Because the preferred site for an airport is on high ground and because high planting in the immediate vicinity is so largely cut off, the airport site is subjected to more horizontal and to lower winds than normal. Moreover, airplane propellers set up air currents which add to the natural winds, so that there is an almost constant change of air around the plants. Hence, atmospheric motion is increased and humidity decreased.

Dust is detrimental to plants as well as to plane engines. It not only affects the appearance but also clogs the stomata, or breathing pores, and so prevents transpiration, finally smothering the plant. If these stomata are set deep in a thick epidermis, as in conifers, the dust is usually fatal. But, if the epidermis is thinner so that the stomata are not so deep, and if, in addition, the leaf surface is glossy, rains will cleanse the surface readily and give the plant a new lease on life.

The poisonous effect of gases on plants presents a different problem and its only solution lies in the natural resistance of the plants themselves. So there is another limitation on plant lists. The necessity of choosing plants carefully to meet the atmospheric conditions on the site — the soil dryness due to drainage, the high wind exposure, and the atmospheric impurities — cannot be overemphasized. Some plants will endure them, others will not. The lists of plants for airport use are limited.

Water. Wherever there is planting, there is need for water. Around airports this need is greater than usual for three reasons:

1. The drainage lowers the water table.
2. The air circulation increases evaporation and transpiration.
3. The intense light also increases transpiration.

The old method of using a hose line involves much labor, and too often means not enough watering, since it is a matter of record that 27,000 gallons of water are required per acre for a penetration of one inch. If the water pressure permits, automatic sprinkler systems are better. Valves for such systems, that drain well and so are not endangered by frost, are now available. Another bit of equipment, newer and less costly to install, is the demountable head.

PLANTING COSTS AND MAINTENANCE

Cost of Planting. Planting and maintenance cost considerably. This fact should be considered and a reasonable sum planned for and included in the airport budget. The outlay for plants may be very moderate, but the relative cost for labor involved is fairly large. Both sums should be included in the general budget from the beginning. Satisfactory labor and plants cannot be acquired for a few casual dollars left over after everything else is completed and paid for. A percentage of the original budget should be earmarked for plants and planting, and a percentage of the general income should go for maintenance of grounds. Also, the maintenance and general appearance of the grounds should be under the authority of some one competent person.

A carefully studied plan should be made before buying any plants. Line, form, texture, and color require study if the results are to be good. A well-devised plan leaves nothing to chance. All the factors of the problem should be taken into consideration before the plants are chosen and bought. A planting plan is a matter of design.

The choice of plants is determined by the characters required to fulfill a design that has been studied in the abstract and finally interpreted in the terms of vegetation. Taking these characters and adding them to the conditions of soil, moisture, light, heat, and air circulation, one finally arrives at the correct list of plants to be used.

Plants thus chosen may be expected to grow and survive with a minimum of maintenance.

Maintenance. If the plants are well chosen the maintenance will be kept low. But no planting will endure in its best effect unless given some attention. Dead wood must be cut out, broken branches trimmed and treated, diseased plants removed and replaced, and all beds cultivated, fertilized, and mulched from time to time. The mulches are important. Too often the maintenance crew carefully removes every leaf and twig beneath shrub plantings, leaving the ground quite bare. Litter or other mulch helps to retain the soil moisture and to keep the soil temperature constant. Both of these conditions are important to the health of the plants. Some ground covers under shrubs, such as Myrtle or Ivy, may hide this litter which seems unsightly to many people. But, whether or not a ground cover is used, the mulch should be left.

A large item in maintenance is the mowing and fertilizing of lawns. Lawns, to persist and serve well, require regular mowing and periodical feeding.

For trees and shrubs a slight yearly pruning is better than a more severe cutting at longer intervals. Among the shrubs, some of the older branches should be cut to the base, thus compelling a renewal of the growth from the low buds. Shearing off the top of a shrub or of a tree is not good pruning. It may thicken the appearance while the foliage persists, but it is very unlovely when the foliage falls. Good pruning requires some knowledge of the plant growth.

Maintenance that is well carried on will keep all planting in good condition over a long period if the choice of plants was well made in the first place.

CONCLUSION

"When we know the relative value of things, we can do anything with them." — Robert Henri, *The Art Spirit.*

It is evident that if the principles of design and their application to the use of plants are known, one has progressed well toward the solution of any planting problem. The planting to be done about any airport resolves itself into factors of use and beauty, and these factors relate to the principles of design.

The attractiveness of the pattern seen from the air and the pleasantness of the ground approach both benefit from the softening effects and shadows provided by plants carefully chosen and correctly arranged. Heat and dust or any suggestion of either create human discomfort. Bareness, barrenness, and glare are unpleasant to the eye. Only the inveterate sun-bather will react favorably to sunshine without shadows. Human comfort, as well as airplane maintenance and safety, all require the use of ground-covers and other plants.

The buildings, whether impressive in appearance or otherwise, can be immeasurably enhanced in effect by correctly placed foliage and shadows. The selection and arrangement of plants to create landscape pictures is a matter of studied composition — of design; and a knowledge of plant character and growth possibilities, as well as of art principles and ecological relationships, is required.

Another problem at the airport is the matter of parking. Parking lots are benefited by shade and, in hot weather at least, any bit of shade will be avidly sought by the driver when parking his car. The approach lanes also are much more pleasant when well shaded. The use and choice of trees merit consideration.

So all the factors of design, service, and function will enter into a good planting plan and the list of plants chosen to be used will provide for both use and beauty at a reasonably low cost for materials, construction, and maintenance. Let the planting be given consideration from the beginning, as are other features of the airport, and the results will be more certain and more satisfactory.

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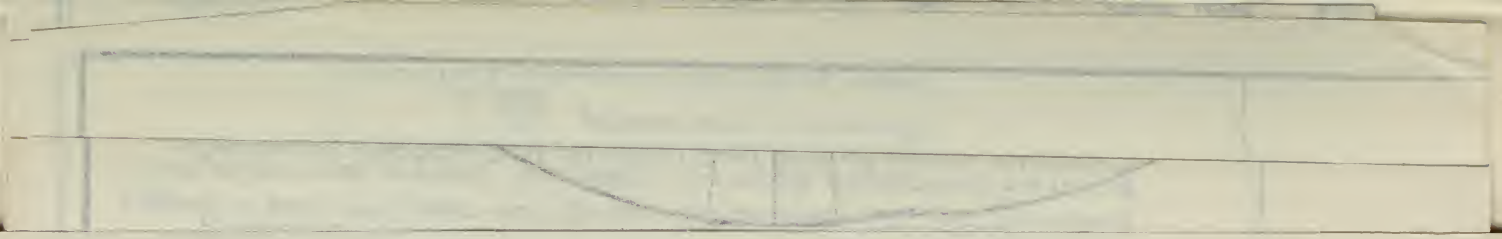

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